Pepper Construction

Quality Technical Bulletin

Concrete Testing 101—Page 1 of 2

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Cure Box

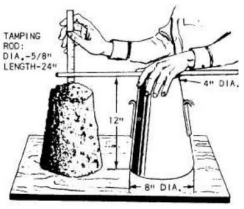
Schmidt Hammer

Winsor Probe

For specific weather conditions, review the Cold Weather Concrete and Hot Weather Concrete plans in your JSQP.

BREAKING GROUND >>>

Concrete testing is one of the most common testing procedures we perform for almost every project. One of the main factors in determining a proper test is variations in operator technique, cleanliness of tools, temperature, and adherence to ASTM standards. It is not the ASTM test itself that is important, it is the consistency of the test that is imperative for quality results. A good concrete product might result in a poor test sample due to inconsistency of the preparation. Always follow procedure and ask questions if you feel something is not being performed correctly.



Corey Zussman, AIA, NCARB, REWC — Director of Quality Management

- **The hired testing agency shall cast all cylinders. Always schedule and verify testing agencies availability several days ahead.**
- We should be testing for slump, air content, unit weight (if lightweight mix), and compression in order to verify we are getting what we requested.
- There are typically two sizes of test cylinders...4”x8” or 6”x12”. 4”x8” needs a minimum of 3 for an average test. 6”x12” needs a minimum of 2 for an average test.
- Typically, code requires a compressive strength test to be an average of two cylinders (a composite sample) taken from the same sample and tested at 28 days. Also, at least one composite sample is taken for each 150cy min. or 5,000 sf of slabs or walls. ***We should take a minimum of 4 or 5 samples for 1 @ 7 day, 2 or 3 @ 28 day + spare.***
- The code does not state that the strength must be a percentage of the design. The code states that the strength is considered satisfactory if the average of any two or three consecutive tests equals or exceeds the specified design strength and no individual test (average of two cylinders) falls below the design by more than 500psi when the design is 5,000psi or less.
- The 3, 7 or 14-day test is used to monitor early strength gains, the 7 day is often estimated to be 75% of the 28 day test. These tests are for information only, however, it is a good idea to know early if an issue exists.
- Cylinder tests results represent a potential strength and not the actual in place strength, as cylinders do not take into account the effects of placing, consolidation, curing, etc.
- The cylinder size of 6x12 shall have a maximum aggregate size not exceeding 2”. A smaller size might be acceptable, based on the project specifications as long as the aggregate size does not exceed 1/3 the cylinder diameter.
- Standard curing for cylinders require them to be stored soon after molding in a consistent temperature environment range of 60˚-80˚ for 48 hours, shielded from direct sunlight, and in an environment which limits moisture loss, such as adding a plastic sheet over to top of the cylinder.
- The typical fracture should break into two conical sections, “cone type”, any other fracture tells us that there might have been an error in the fabrication, storage, curing, or testing of the sample. So, the information that the “type of fracture” reported tells us is for reporting purposes only. (See page 2)
- Laboratory-cured or non-field cured cylinders are commonly used to verify strength range and quality control. We typically should be using this method, which includes a heated curing box, in cold weather.
- Field-cured cylinders, cylinders allowed to cure in the same exact conditions as the concrete-in-place, are commonly used to verify removal of forms, shoring, post-tensioned concrete, or service usability only.
- Intentionally entrained air should NOT be added in normal weight concrete that will be polished or machine-troweled surface. This will cause blistering and delamination.
- **Normal weight concrete cylinder tests are different than structural light weight concrete cylinder tests… ask the tester if you do not see a difference in the procedure.**
- If core tests are required due to low cylinder tests, these tests have a different criteria of acceptance. Three cores are taken and if the average is at least 85% of the design and no single core is less than 75% of the design, the concrete in-place is generally acceptable.
- Surface tests, such as the Winsor Probe or Schmidt Hammer do not directly measure compressive strength, They measure a property (surface hardness) which is correlated to compressive strength established and correlated with each sample.
- There are many factors that affect surface type tests, such as surface smoothness, finish, moisture content course aggregate type, carbonization, etc.
- Surface type tests are useful when in-place strength must be known or cylinders have failed. We could use these tests to let us know when forms could be stripped, shoring removed, when post tensioning forces can be applied, etc.

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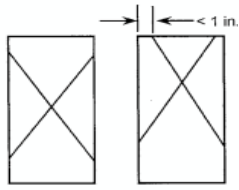
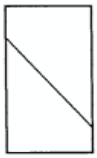
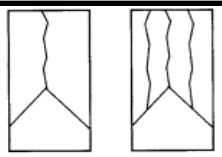
Common Cylinder



Type 1
Reasonably well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps
(Type 1 is most common)

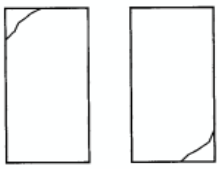


Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type 1

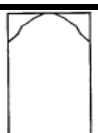


Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones



Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)



Type 6
Similar to Type 5 but end of cylinder is pointed

►There are four (4) ways to measure air content: Pressure, Volumetric, Gravimetric, and the quick check through a pocket indicator.

Pressure Method ----------Not suitable for lightweight concrete

Volumetric Method ----------Typically used for lightweight concrete

Gravimetric Method ----------Compares actual weight and theoretical weight of the materials based

Pocket Method ----------Used as a quick check only

►We should be testing the concrete either at the point of placement or at the point of discharge...There are reasons for doing both, which need to be discussed with the EOR and the Pepper Team:

Point of Placement ----------More accurate air content values (as long as the pump is NOT slowed down) and a more accurate account for any "on site adjustments", such as added water or chemicals/air. **THIS IS THE PREFERRED LOCATION WHEN THERE IS A PUMP.**

Point of Discharge----------Clear responsibility of the concrete by the Concrete producer, however, we MUST get any added water or chemicals for the cylinders to be a true representation.

►Common testing errors, which could fail a otherwise good concrete pour:

Slump Test ---------- Tested on a non-level surface
- Surface is NOT moist or absorbent
- Shearing of the cone when twisted

Air Content ---------- Pressure Test Method
- The sides of the bowl not being properly tapped after each rodding.
- The meter bowl not full after consolidation
- A clean and moist bowl before testing

Compressive Strength Test---Any deviations or interruptions from normal testing and curing procedures

Other Common Issues --------- Cylinders filled without rodding or vibration
- Cylinders NOT kept at 60˚-80˚ for 48 hours
- Cylinders allowed to dry out before transporting them to the lab for final curing
- Taking the cylinders BEFORE water or added chemicals are added.

►**Concrete testing should never be taken before the 10% & after 90% of the batch has been discharged.**

►Making a normal weight concrete cylinder (it needs to take no longer than 15 min. maximum total):

1. Test for Slump, Temperature, & Air (5 min. maximum)
2. Place the concrete in mold AFTER everything is added.
3. Molds must be on a level, rigid surface, free of vibrations.
4. Concrete is added to the cylinders in three equal lifts
5. A steel rod is jabbed into each lift of concrete 25 times (rodding)
6. The sides of the cylinder is tapped with a mallet firmly to remove any air bubbles.
7. The top of the cylinders are struck off cleanly with the rod.
8. The cylinder is then marked.
9. Cylinders are then located in a cure box or a safe place as described in this bulletin.
10. Cylinders are to be transported no earlier than 8 hours after final set.

►Concrete can be rejected only after two (2) slump tests or (2) Air tests are taken and fails from the same sample.

►In cold temperatures, we should make a cure box and install a 100 watt incandescent light bulb or other, non-carbon heat source and a min/max thermometer. We must make sure that we monitor the temperature often in order to ensure the box remains with-in the testing specifications.

►**Always review concrete tickets prior to the start of the pour.** Review for the time from loading to discharge: *plant to placement maximum time: Less than 85° = 90 min. / 85°-90° = 75 min. / 91°-Higher = 60 min. Verify accelerator use and verify timing requirements,* CORRECT ADDITIVES, NO CALCIUM CHLORIDE, etc.

IF THE CONCRETE IS NOT CORRECT OR THE TRANSPORTATION TIME TOO LONG — WE MUST REJECT THE LOAD!